DOCUMENT RESUME

ED 179 317 PS 011 065

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TITLE Peer Interaction as a Source of Cognitive Developmental Change.
SPONS AGENCY Spencer Foundation, Chicago, Ill.
PUB DATE Sep 79
NOTE 10p.: Paper presented at the Annual Meeting of the American Psychological Association (87th, New York, NY, September 1-5, 1979): Paper based on Ph.D. dissertation, Tufts University

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cooperation; *Developmental Stages; Elementary Education; *Elementary School Students; Grade 5; *Group Behavior; *Map Skills; Participant Involvement; *Peer Influence
IDENTIFIERS *Equilibration; Map Drawing Ability; *Piaget (Jean)

ABSTRACT

The effects of peer interaction as it relates to equilibration in the development of map drawing activity was studied in 72 fifth graders. The children were pretested and placed into 36 same sex pairs for training on the basis of Piaget and Inhelder's six-stage sequence of map drawing ability. A discrepancy (above, below or at the same stage) between each subject's pretest modal stage and a partner's modal stage was used to define an external disequilibrium condition for each subject. To explore relationships between peer interaction and developmental change, an observer coded utterances between partners and assigned each pair an involvement rating. An observation system permitted subjects' overt behavior during exposure to external disequilibrium to be related to changes on posttests. Results confirmed a significant effect of discrepancy between peers at differing stages in promoting developmental change. External disequilibrium due to developmental differences between partners both within and between stages produced similar patterns of change. Pair involvement rating and frequency of on-task discussion were also found to be significantly related to advance.
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ED179317

PS 011065

Peer interaction as a source of cognitive developmental change*

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Piaget has proposed that children develop increasingly advanced intellectual systems through the process of equilibration. Equilibration involves interaction between the internal cognitive state of the individual and factors which he or she encounters in the external environment. A number of recent short-term training experiments (Inhelder, Sinclair & Bovet, 1974; Kuhn, 1977; Snyder & Feldman, 1977; Turiel, 1969) have tried to examine more closely the nature of the equilibration process by manipulating the extent to which information is discrepant from children's own cognitive stage. Researchers have been able to make inferences about changes that occurred during training by then measuring post-training changes in performance. Another kind of "training" study has involved examining whether cognitive advance may be fostered by peer interaction. These studies (Botvin & Murray, 1975; Murray, 1972; Silverman & Geiringer, 1973; Silverman & Stone, 1972) suggest that interaction with more cognitively advanced peers is effective in helping children acquire certain conservation skills. One weakness in many of these training studies however, is that, by and large, they focused on the outcomes of the training rather than on the equilibration process itself.

* The research reported here is based on a PhD dissertation at Tufts University by the first author and under the direction of the second author. Support was received from a grant from the Spencer Foundation to the second author. Thanks to Lynn T. Goldsmith of MIT for helpful comments and editorial assistance.

This paper was presented at the Annual Meeting of the American Psychological Association, New York, September, 1979. A longer version is in preparation.

The present study is an attempt to combine the two types of training studies described above. It examines peer interaction as it relates to equilibration in the development of map drawing ability. Piaget and Inhelder used map drawing as an indicator of the development of spatial representation ability. Peer interaction seems to be well suited for the study of equilibration. Children's discussions as they work on a cooperative activity can provide information about the kinds of cognitive confusions and dilemmas which may then lead to advances in performance. In addition, there is some evidence that situations which encourage confrontations between a subject's own stage and information representing more advanced stages are more likely to facilitate advance than other more passive forms of exposure. As partners work cooperatively on a problem which requires agreement, less advanced children may be required to accommodate to the more advanced techniques their partners are using.

The present study had a pretest-treatment-posttest-delayed posttest design. 72 fifth graders participated in all phases of the study. Children were placed into 36 same sex pairs for training on the basis of pretest map drawing scores. The pre-, post- and delayed posttest instrument was Snyder, Feldman and La Rossa's (1976) map drawing exercise, which is based on Piaget and Inhelder's (1948) six-stage sequence of map drawing development. The task requires each subject to draw a map of a miniature village landscape. Each drawing was scored for the subject's modal stage, or the most frequent stage of response reflected in the drawing.

In the second phase of the experiment three main treatment groups were formed. The positive discrepancy treatment group consisted of 24 subjects

whose partners during the treatment phase had map drawing scores above their own; the 24 subjects who therefore worked with partners below their own formed the "negative" treatment group; and 24 subjects working with partners at the same stage formed the "neutral" treatment group. In forming the pairs, children were matched with partners from other classrooms to partially control for the effects of familiarity on the interactions during the treatment phase.

Treatments (which occurred within two weeks of the pretest) consisted of dyads working on cooperative map drawings of a second village model which differed in several respects from the original landscape. The two children were asked to make one drawing together of the new model. It took partners an average of about 40 minutes to complete their maps. During the entire procedure a trained observer, unaware of the children's treatment groups, coded utterances that occurred between partners. At the end of each procedure the observer also rated pair members for their general level of involvement in drawing the map. A five point involvement rating scale provided a general indication of the quality of interaction and level of interest in the task.

In the posttest and delayed posttest phases, the children drew individual maps of the original landscape, approximately one week and again 5 weeks after the treatment phase. Interjudge agreement on the scoring of maps from pre- and posttest phases was at least 85% on randomly selected samples.

Since previous research has shown that discrepant information above a subject's own stage is effective at promoting advance and that information at the same stage or below is unlikely to produce change, we predicted that those children who were exposed to discrepant information more advanced than their own would advance with significantly greater frequency than subjects working with partners at or below the same stage. In other words, we predicted that children in the positive discrepancy condition would advance more often than those in the negative or neutral conditions. We also expected that those children in the positive discrepancy condition who advanced would have been dominated in discussions by their more advanced partners with greater frequency than those who did not advance. This prediction was based on the results of two earlier peer interaction studies, where it was found that nonconservers advanced when their conserving partners dominated the interactions and when the nonconservers yielded to the responses of conservers.

We were also interested in looking more informally at the effects of various external manifestations of equilibration. Such factors as the role of involvement between partners and the number and kind of utterances occurring during the treatment phase were examined.

The first prediction, which was about the effects of treatment condition on modal stage advance, was confirmed. A main effect of treatment was obtained on both posttest and delayed posttest using multidimensional chi square analyses. Contrasts revealed that subjects in the positive discrepancy condition advanced with significantly greater frequency than subjects in the negative or neutral treatment groups. Figure 1 shows the

frequency of advance for the different treatment groups on the post- and delayed posttests. Our predictions concerning the effects of dominance and yielding were not confirmed, however. More advanced partners did not dominate their interactions with less advanced subjects in terms of the amount of discussion about the task. Similarly, it was not found that the less advanced subjects made more gains when they yielded to their more advanced partners.

Figure 2 shows the percentage of advances as a function of involvement for the 3 treatment groups. Level of involvement was actually found to be a better predictor of advance than the child's treatment condition for the 1-week posttest but did not predict advance on the 5-week delayed posttest. For the first posttest, subjects in pairs rated high on involvement advanced with much greater frequency than did those who were rated low on pair involvement. Thus, there was an interaction effect of involvement rating and treatment condition. For highly involved individuals, the positive treatment condition contributed most to advance and the negative treatment condition contributed least. However, for those subjects in the negative and neutral treatment groups whose map drawing scores advanced from pre- to posttest, all were among subjects rated high on involvement. In the absence of positive discrepant information, subjects only advanced on the first posttest when they were highly involved in the task of drawing a map with their partner.

As for the measures of verbal behavior, the mean number of on-task utterances during the treatment phase was found to be related to advance on posttests. Subjects who advanced in posttest modal stage had a

significantly greater number of on-task utterances than subjects who did not advance. This effect was independent of both the treatment condition and the more particular nature of the on-task discussion that occurred. Analyses also indicated that children who received high involvement ratings had significantly more on-task utterances than subjects who were rated low on involvement. In addition, mean number of on-task utterances was also significantly related to map drawing advance. Subjects who advanced talked more about the task and were more involved than subjects who did not.

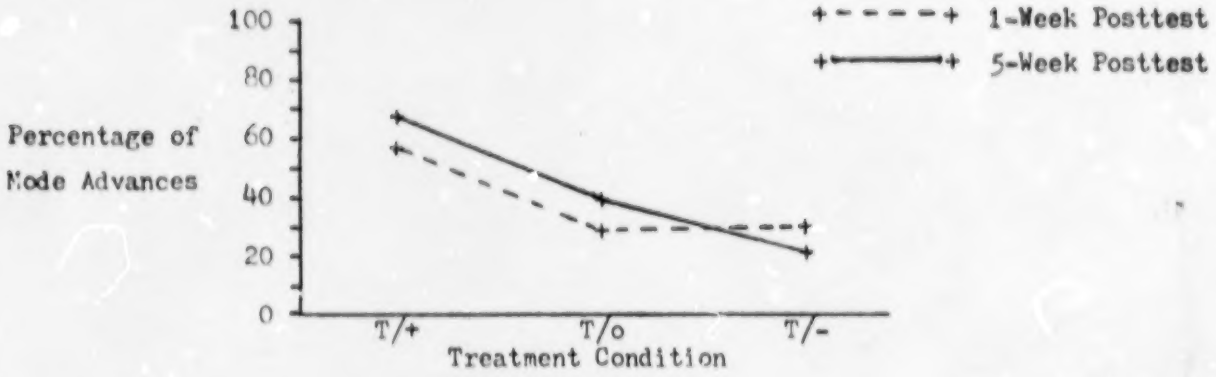
To summarize, the major findings supported the hypothesis that peer interaction among subjects at different cognitive developmental levels was effective at promoting long-term advance in less advanced partners. Predictions concerning the external manifestations of equilibration, namely yielding and dominance, were not confirmed, however.

Perhaps the most interesting finding was the interaction between the involvement rating and treatment condition. In the short-term, i.e., at the first posttest, involvement ratings were highly related to advance. Furthermore, neutral and negative treatment condition subjects only advanced on the first posttest when they were highly involved. This suggests that even in the absence of information above one's own cognitive stage, advance may occur during some extended interaction with peers, but only when one is highly interested and actively involved with the partner in the activity. Secondly, it suggests that cognitive developmental advance through equilibration may indeed by observed in peer interaction situations. The involvement rating scale was only a general assessment based on observer impressions.

The further finding that the number of utterances about the task was related to both advance and involvement scores points to the possibility that some measure for observing the equilibration process as it is occurring could be developed further in future research, perhaps including a more refined notion of involvement and perhaps including analyses of the specific content of utterances that lead to advance. We are currently engaged in such analyses. However, the finding that effects of treatment were more long lasting than effects of involvement suggest that in the long-term the information subjects received during treatment is the most powerful predictor of advance.

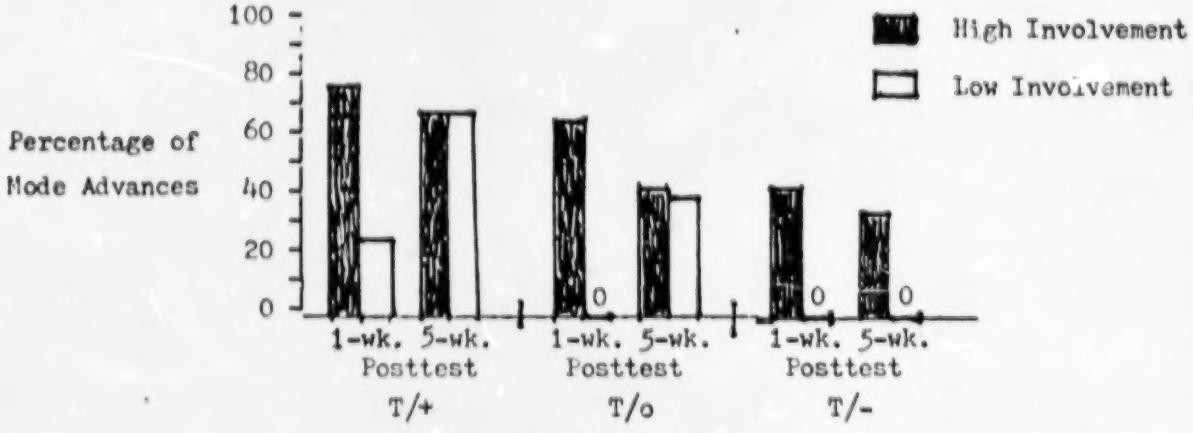
The present study represents an early attempt to look at peer interaction as it relates to equilibration. The findings confirm the value of peer interaction in promoting cognitive advance in this domain. They point to the value of such measures as level and kind of involvement and number and kind of utterances in giving texture to our knowledge about developmental advance. Finally, these results suggest that peer interaction is a fruitful approach to studying the equilibration process. When partners at different stages confront each other in a challenging task, some aspects of the equilibration process are externalized for the experimenter to see.

Figure 1
Percentage of Advances in Map Drawing Mode by Treatment Condition



	1-Week Posttest	5-Week Posttest
Total Advances:	35% (25/72)[a]	42% (30/72)
T/+ versus T/o and T/- Advances:	$X^2(1)=6.01$*	$X^2(1)=9.26$**

Figure 2
Percentage of Advances in Map Drawing Mode by Treatment and Pair Involvement



Total Advances:

Pair Involvement	1-Week Posttest	5-Week Posttest
High	57% (23/40)	47% (19/40)
Low	6% (2/32)	34% (11/32)

[a]Numbers in parentheses indicate proportion advancing
* = $p<.05$
** = $p<.01$

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